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WINTER STUDIES: GALLS AND BIRDS.

I.

VERY still and thick is the November day. As the eye moves up the steep slope of brushwood, the crags that top it, where the kestrel breeds in spring are found to be lost in mist; they melt into atmospheric haze. The brown oak-leaves that still deck the coppice are bright with damp—nature's varnish! and though lately resonant under the music-bow of a chill north-eastern, they to-day whisper not a tone. That big brown bird that suddenly shoots straight down into a bush, makes no sound either, whether it has found prey or not; for the sparrow-hawk slays by silent speed. Only one small voice breaks the whole misty stillness, with a cheery high call of *zip, zip, zip*.

This is the marsh titmouse, that, defiant of danger, ranges the woods in loneliness; and that too at a season when small birds instinctively seek company. But he is a creature somewhat fond of his own ways, that is certain; he does not care to be always following a leader, nor to be bound to move on with the pack whether ready or not. Besides, this morning he is about a very particular and engrossing business, and if we follow him into the wood, we shall find out by induction what his business is, and why he may frequently be seen to catch with his beak at leaves withering upon the stem, and to toss them down in an investigating manner.

Down on the damp floor of this wood are strewn quantities of oak-galls, round and large as cherries, scatterings from a very bounteous crop that still hangs upon the unshed leaves. Now many of these fallen galls are broken open, and riddled through and through, as if by a little bird's beak. It is this very marsh-tit, no doubt, that has been at work upon them. And if we reach up and pluck a few of the leaves that bear still on their under surface one or more of the sound galls,

and carry them home for examination, we shall understand not only the birds' attraction to them, but a fragment of a very wonderful life-history.

These cherry-galls, as they are appropriately called, round, and just touched with red, as if in ripening, are not fruit, though borne upon the tree. Nor scarcely can they be called disease, for the tree and the leaf that bear them seem to suffer no whit from their presence. They are really the nurseries for the young of a hymenopterous creature called *dryophanta scutellaris*. The cunning mother-fly, that might not live to foster her offspring, pierced the leaf when it was young and tender, and laid an egg within the puncture; and caused thereby such a diversion of the energies of the tree, as not only built up a little room about her progeny as it grew, but actually supplied the little one with food; thus turning the giant tree into the tiny *dryophanta*-grub's foster-mother.

Now if we cut open some of these little spheres, we may chance to find youngsters in three different stages of growth within them. Here is the larva, a curved white grub, ringed, scarce a line in length, that wriggles its pointed end. It has no feet; why should it have, when it has nowhere to go, and has nothing to do but lie in a comfortable mass of spongy tissue, and to suck in the milk of the tree? (A vast feeding-bottle, this, in truth!) But it has a fringe of fine hairs below, only to be seen with a glass, that no doubt give it powers of adhesion. Here again is the pupa, which has done now with feeding. Through its transparent skin shows the black back, while the growing limbs give new shape to the case. And here, actually, buried in the tissue, is a perfect creature, a gall-fly complete! At present it lies in its tomb motionless, with round black head placed towards the skin of the gall, through which it is ultimately to find its way. Perfect in development, with folded wings and closed legs it awaits the supreme moment of entry into the world. But now, still as it was a moment ago, the light and (probably) the warmth of the room, begin to affect it. It thinks delusively that the supreme moment is here. It stirs its limbs; it lifts itself from its birth-posture; and as its wings dry and harden in the air, it expands them (what lovely iridescent surfaces they show, all set in plates like leaded windows!) strokes them

with its hind legs; and after proving them in various ways, and lifting them above the hump-back on which they are set, our *dryophanta* feels itself ready, and starts its life-journey by a brisk trot on six active legs across the table—one of the million of Nature's children destined never to fulfil the functions of its complicated life.

But even if this gall-fly had been fortunate above the host of its fellows—had not only enjoyed a favourable season like the present for the hatching of the egg—had escaped the bird in its grub stage, and the encroachments of the lodger-flies that take advantage of these gall dwellings—and had when it crept forth perfected on the floor of the wood, found conditions that suited it, its life history would still not be complete. For, matured in mid-winter, with mother never seen nor green leaf on which she laid the egg, it would seem impossible for this fly to sustain life long enough to repeat her action. How then can it propagate its species?

Here, happily, Dr. Adler (whose book has just been translated) comes to the aid of the questioner. He has conclusively proved, after years of experiments, not only that the cherry-gall-fly's offspring is born in quite another kind of gall, but that that gall is the one that caps the leaf buds on the oak stem with purple velvet swellings in the spring, and has been named *Spathogaster Taschenbergi*. So our fly now before us (of which females only are produced) would immediately seek if it could—is seeking now in fact, an adventitious bud of the winter bough of the oak, such as in a natural state it would be sure to be near. It would then, piercing the bud, lay its egg therein, and so be done with its solitary unmated life, long before the quickening pulse of spring begins to beat strong within the tree.

Its month of emerging, however, is by no means fixed. I have kept cherry-galls that have been quitted by their tenants, by means of a tiny hole bored through the skin, on successive days through a mild December. I have seen a fine strong fly, in the brilliant sunshine of February 13th, taking its long hopping flights on a hard crust of snow, clearly quite out of its road. Dr. Adler says that the fly already developed by December remains within the gall so long as a frost lasts, emerging when the thaw comes, which rots its snug round house; so that its appearance depends largely on weather.

Thus a day or two of wintry sunshine is all this fly's natural term of life. The eggs it lays upon the buds develop by the end of May into flies that are much smaller than it, and are of two sexes. The female of these soon begins to probe the young and tender oak leaves then spreading about the branch on which she was born, and repeats the action of her grandmother, by piercing a vein in its under-surface and laying an egg there; and this egg in due time will become a winter-emerging *dryophanta*, like our brisk table-trotter.

Two generations, therefore, each showing three distinct stages of growth, are needed for the perfecting of the existence of this one minute creature, scarce two lines in length. It lives solely on the juices of the giant tree. The tree makes the juices by a process that a chemist scarce can explain, from the cosmic forces of sun, air, water, earth. Nay, in the tree's action is involved the whole solar system, with the seasons that are governed by the sun. The tree then nourishes from its superabundant store the fly, the fly supports life in the small bird, the bird falls a prey (a cruel link!) to its larger fellow. Sun, earth, tree, fly, bird are all connected; for Nature is one vast whole, with all her parts interdependent.

II.

Clear is the air, blue the sky, for a light wind blows from the north, and last night's frost is visible yet. The Rothay races swift and strong again, after autumn rains, beneath the arch of the footbridge, and its tributaries of Scandale and Stockdale pour their waters noisily into it, where it has retreated under Loughrigg. On its banks every tree is leafless. Only the ash trees hold their seeds aloft. The mid-November storms of wind and rain have swept the last of the great oak trees bare, and now the woods stand in rigid winter nakedness about the lower slopes of the great pale mountains.

Very singular is the position of some small oak-groves on the valley flat. This oval stretch encompassed by hills, widening from the Rydal pass to the great lake of Windermere, has been long drained, and its errant stream-courses walled and confined, so that every foot of its alluvial soil may be used as grass and pasture land. It is flat as lake

water, but here and there rocks rise abruptly above the sward, in short hummocks, like islands from a sea—and no doubt they were islands once, in the sea of broad glacier which swept (without seeming motion) from its source on the heights of Fairfield, and which ground and scored these rocks in a way that may yet be traced on their sides and northern faces.

Now just from these hummocks the native forest that afterwards, and in a warmer era, clothed all the land, has never been ousted. Pushed back ever by scythe and plough, it has held to them like fortresses; and so wonderfully do the roots of the trees (which no doubt started as acorns dropped into crevices) coil and twist in places over the naked slate, to find and pierce the soil around, that they have all the appearance of having veritably climbed the rocks from below, in order to throw aloft at the top their strong standards of trunks. These crowning oaks, too, are bare of leaf; and quiet and birdless as the whole landscape has hitherto looked, as we approach a clump of them four or five cock-chaffinches get quietly up from their shade and perch upon the higher pinnacles of the rock to see if it would be wise to await events there, in the passing of the watcher. It would not; for the action of the chaffinches has excited curiosity, which must, if possible, be satisfied; and off they go.

What were those stealthy-looking birds doing on the ground? All birds, when bent on treasure-trove, have a peculiarly secretive air. What happens to be the treasure here? The chaffinch is no ground-worm eater, like the thrush, nor (as far as I know) does it masticate the acorn; besides, no fruit of the tree lies below. No true fruit, certainly! Yet, if we do but remember, a kind of fruit—an animal fruit—if so paradoxical expression may be allowed for a moment—is actually shed by these trees, and is now lying thickly below them. For the oak trees, which are the favourite breeding-ground of so many species of gall-flies, have this year (1895) borne upon their leaves an extraordinary crop of spangle-galls; and, indeed, so closely have some of the leaves been studded with galls, that the round things have lain against one another, overlapping like coins in a heap. For the wonderful story of the spangle-gall, of how it was produced by the fly born from the round currant-

gall (which we observed to vacate its home from first of June days), and how it laid its eggs—no winter-bud, such as its own mother pierced, being ready—in the tissue of the tender leaves, thus causing a vegetable house to grow about its offspring—for all this we must refer the reader to Dr. Adler's book on gall-flies. We have only to do with the flat spangles that have now become loosened from the leaves, and are strewn around the trees in thick profusion, especially where the rain has washed them into the crevices in heaps. Such odd little objects, flat and round, green, or of purpley tinge (for the gall is studded with red bristles or hairs in sets, upon the side that was outermost on the leaf); clearly a thing of vegetable growth, and yet most clearly amongst the rotting leaves, living! The fact being that the little animalcule alive within this vegetable plate, keeps it in condition. And if we break a gall open we shall find a white gleaming body (not plainly perceptible without a magnifier) lying separate from the walls of its house, and not, as at an earlier stage, embedded in vegetable tissue; for it has now done with the feeding stage, along with its severance from the oak that nourished it, and has but to await its development as a fly.

Now the chaffinches appear to have learned the secret of these round bits of vegetable that contain (like pork within a piecrust) animal matter within. On the spot whence we surprised the birds, many spangles are at once discovered freshly broken open, their beak-nipped edges yet unshrivelled, and the grub so neatly abstracted, that the shell at first sight scarce seems empty. Tasty enough the grub must be, but oh! how small, even for chaffinch-gizzard! The whole gall is not in general more than two lines across, and the grub is in the centre, beneath the peak.

This is not the first time the chaffinches have lunched off spangle-galls, be sure! On the other side this rock, we can find a good deal of broken gall shell, already becoming disintegrated and formless—for the house without its tenant falls to pieces at once. Nor is it to be the last.

Day after day do we watch the birds come to the oak trees. Presently they come in a large nomad flock—nay, in two distinct flocks, that keep apart, numbering twenty to thirty birds each, principally (if not all) cock chaffinches.

They pitch into the tops of the trees on arrival, as wild shy bramblings will; then, seeing all quiet, at a given signal-note they all drop to the ground, and run to and fro, picking and eating in silent engrossment. Till finally, the early winter banquet is over, the ground is about cleared of galls, and the birds must seek elsewhere for food. And only here and there can it chance that a spangle-gall, entangled in thick moss, or buried in a deep crevice, has been overlooked by the oft-coming, sharp-eyed trippers, and so has escaped the general slaughter. Thus may its inhabitant, emerging from the long slumber in its buried husk, rise in early spring days as a winged thing, that shall pierce the unfolded leaf-buds and lay eggs therein for the making of a new generation of pendant currant-galls.

But what would the plagued oak trees do without the birds, that thus clear for them the bulk of a parasitic population?

MARY L. ARMITT.

ON TRUE EDUCATION.*

By W. J. TYSON, M.D.

My adjective before the subject under discussion points to a line of treatment which is not always intended when the word Education is employed. Education, in this paper, is used to describe the training of the whole man, physical, intellectual and moral (spiritual) from birth to old age, in their due order of growth and development. I wish to say a few words touching these three parts of our being, beginning with the first.

In speaking of the physical side of our nature it is essential that something should be known of the physiology of the body. Human physiology has been defined as the science which treats of the life of man, of the way in which he lives, moves, and has his being. It teaches how man is begotten, and born, how he attains maturity, and how he dies. The essentials of life are: birth, growth, development, decline and death. Birth is not the beginning of life, but a period in the life of the animal when it can exist more or less independently apart from its parents. Though, it must be remembered, this power to live without maternal help becomes less and less as we ascend the animal scale. Growth is the inherent power, possessed by the body, to increase in size. Development refers rather to quality than to quantity. It means the functionising of the organs of the body, so that they become more and more fitted to perform those duties for which they were originally intended. Thus, a body not only grows but develops, and development is of even higher importance than growth. It would be difficult to say when development ceases and decline begins. The two may even exist together, but the decline soon becomes more and more apparent and is ultimately followed by death. At this stage

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